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Evaluation of the Massachusetts Office of Technical Assistance and Technology's Chemical Safety and Climate Change Resiliency Services

Daniel James Sullivan
Worcester Polytechnic Institute

Matthew John Cannata
Worcester Polytechnic Institute

Przemyslaw Marek Gardias
Worcester Polytechnic Institute

Shaye Elizabeth Johnstone
Worcester Polytechnic Institute

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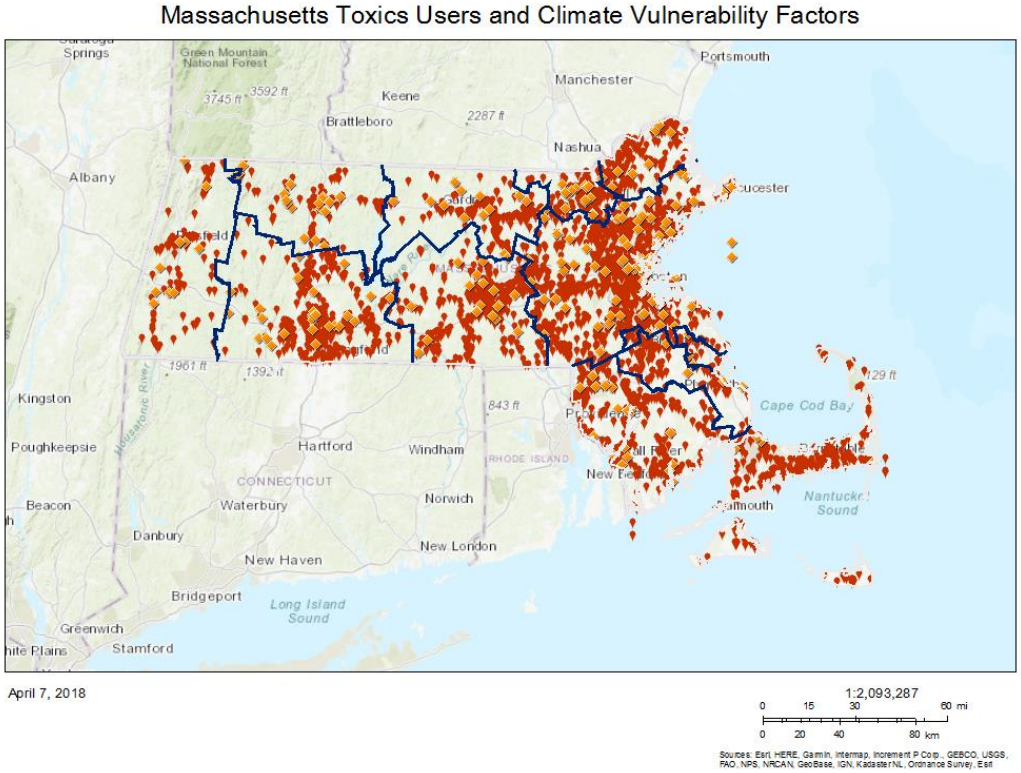

(Tabuchi et al., 2018)

Matthew Cannata | BME | 20'
Przemyslaw Gardias | CS | 20'
Shaye Johnstone | CHE | 20'
Daniel Sullivan | CS | 20'

Sponsor: Office of Technical Assistance and Technology

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In partial fulfillment of the requirement for the
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Matthew Cannata | BME | '20
Przemyslaw Gardias | CS | '20
Shaye Johnstone | CHE | '20
Daniel Sullivan | CS | '20

Project Advisor: Professor Seth Tuler, Worcester Polytechnic Institute
Sponsor Contact: Tiffany Skogstrom, Office of Technical Assistance and Technology

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Abstract

Climate change has caused an increase in severe weather patterns. Wind gusts, extreme temperatures, and extreme precipitation can cause floods, structural damage, or power loss to toxics-using facilities, leading to risk of chemical disasters. The goal of our project was to assess the effectiveness of the MA Office of Technical Assistance and Technology's (OTA) climate change resiliency and chemical safety program. The program supports the Toxics Use Reduction Act and consists of trainings and confidential site visits. We defined criteria to determine program effectiveness and interviewed and surveyed program participants to gain feedback on their experiences. We used this feedback to develop recommendations to improve the future trainings, site visits, online resources, and feedback.

Executive Summary

Risks Posed to Chemical Facilities by Climate Change

As the average temperature of the Earth continues to rise, there has been an increase in the frequency and severity of severe weather patterns (National Climate Assessment, 2014). These severe weather patterns cause flooding and can include spikes in wind gusts, heat, and extreme precipitation, which can pose dangerous risks to facilities which store toxic chemicals. Floods, structural damage, and power loss are common causes of chemical release, that pose risks to surrounding ecosystems and populations (Missouri Department of Health and Senior Services, n.d.). Within the United States, there are over 22,000 facilities which use toxic chemicals (Environmental Protection Agency, 2015). In Massachusetts alone, there are about 400 toxics using facilities, as shown in Figure ES.1 (Environmental Protection Agency, 2016).

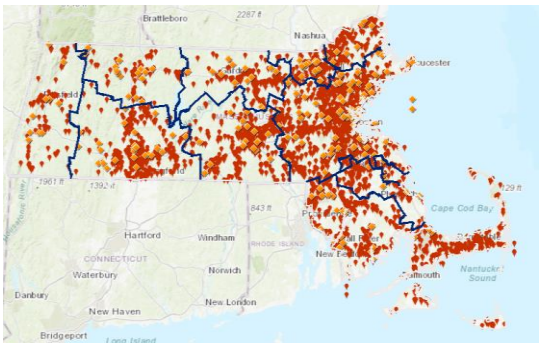

Figure ES.1 *Toxics use sites in Massachusetts. Orange markers indicate National Pollutant Discharge Elimination (NPDE) discharge sites and red markers indicate EPA-marked Tier 2 sites. Regional Planning Agency boundaries are marked with a dark blue line (Massachusetts Toxics Users and Climate Vulnerability Factors Map).*

Toxics Use Reduction

While there are many approaches to reducing the risk of accidents involving toxic chemicals, the safest and most effective solution is to reduce the amount of chemicals that are stored in a given facility (Office of Technical Assistance and Technology, n.d.b). This approach, called toxics use reduction, minimizes the risk of accidents and possible exposure in the event of an emergency (Office of Technical Assistance and Technology, n.d.b). In 1989, Massachusetts adopted a law to promote the policies of toxics use reduction, titled the Toxics Use Reduction Act (TURA).

Office of Technical Assistance and Technology

To support Massachusetts' toxics-using businesses, the OTA provides free, confidential technical services to assist toxics users in toxics use reduction. An EPA grant allowed the OTA to partner with seven Regional Planning Agencies in Massachusetts to hold free training sessions for first responders, municipal workers, toxics users, and other invested individuals that might benefit from the OTA's services.

The OTA has hosted a total of 14 toxics use reduction trainings and seminars across the state of Massachusetts since September 2017. The OTA plans to continue the program and hopes to improve it based on the feedback of past participants.

Goal

The goal of our project was to assess the effectiveness of the Office of Technical Assistance and Technology's climate change resiliency and chemical safety program, consisting of trainings and confidential site visits, and develop recommendations for improvements that can be made to the program.

Objectives

To achieve the goal we completed three objectives:

Objective 1: Developed criteria for assessing program effectiveness
Objective 2: Evaluated program based on identified criteria
Objective 3: Developed and delivered recommendations to the OTA for improving the program

Findings

Our evaluation is based on feedback from 1 first responder, 3 municipal workers, 22 trainings attendees, 9 site visit participants, and 213 RPA training surveyees. OTA provided us with contact information for the 197 individuals who included their contact information in training surveys or have hosted site visits within the last three years. A limitation of our study is the relatively small response rate from the survey and the small number of interviews, as shown in Table ES.1.

	Interviews	Surveys
Emails Sent	197	
Emails Bounced	Unknown	32
Scheduled Interviews	12	N/A
Completed	9	19
Initial Response Rate	16.3%	N/A
Completion Rate	11.1%	11.5%

Table ES.1 *An outline of interview and survey outreach and response statistics.*

Criteria for program effectiveness

Our criteria are defined in Table ES.2. They include descriptions of each criterion along with examples of a threshold for success. These criteria served as a guideline for measuring the effectiveness of the OTA's services in Objective 2.

Criteria	Description	Example of Success
Relevance of Services	OTA services are relevant to the needs of their clients Information provided directly benefits the organizations seeking help via OTA trainings or other services	5+ rating given Expectations met
Relevance of Recommendations	Clients are able to make changes related to their process, their facility, their trainings, etc. without being completely impeded by barriers (e.g. cost) OTA ability to provide reasonable recommendations, sensitive to the needs of the company with respect to possible barriers	Reduced usage of chemicals and improved chemical storage for severe weather conditions Already implemented or intent to implement changes based on OTA recommendations Revised or intent to revise risk management plan with local first responders
Client Satisfaction	Clients are satisfied with OTA trainings and other services	Inclusion of phrases/words such as "I liked" or "helpful" Willingness to continue to work with the OTA

Table ES.2 *Outline of criteria for program evaluation with descriptions and examples.*

Assessment of the program based on identified criteria

Findings from RPA Survey Responses

We obtained access to previously administered surveys filled out by training attendees, consisting of a pre-training survey, linked on the informational pamphlet that advertised the training locations and dates, and a post-training survey by the RPA which hosted the training. The 213 responses to these surveys were compiled in order to gain insight into the trends in the opinions of the participants, which were then used to identify and support possible recommendations for the OTA trainings.

Surveyees have a need for and interest in OTA trainings. 53.7% of surveyees who took the pre-training survey responded that they had conducted a hazard analysis and prepared an emergency response plan within the last two years. This shows that

companies have interest in subjects included in the services that the OTA offers and that their services are relevant to the companies' values. The existence of companies who have not recently conducted the hazard analysis and emergency plan suggests that the OTA's services are needed.

Surveyees found the tools and resources presented at trainings inspiring or useful to their situation. According to RPA surveys, company interest in the trainings is supported by responses of 77.1% of surveyees in the post-training survey, who indicated that they were beginning to implement changes with the intent of reducing toxic chemical and material usage. This finding is consistent with the findings from our own outreach.

OTA services are insufficiently advertised to the companies who may require assistance. Responses to a question on the post-training survey which inquired about the surveyees familiarity about the OTA's confidential technical services indicate just over half of the training attendees were unaware of the OTA's technical services. This indicates that many companies who could benefit most from the OTA's technical assistance were unaware of these services.

Findings from Our Interviews and Surveys

We scheduled 12 interviews with OTA participants through contact information given to us by the OTA. In total, we interviewed 9 of these people, including 7 toxics users, 1 municipal worker, and 1 first responder. Two of these interviewees had site visits in the past. We received 19 responses to the survey that we had sent out, asking questions that were similar to those in our interviews so that we might compare the data from both.

Trainings could benefit from an active, hands on, or mock disaster scenario component. The first responder who we interviewed suggested the addition of hands on activities in order to increase audience engagement, and that there is "a strong need to do… real time training, in other words, doing a mock session"

Trainings met municipal staff expectations. Three municipal staff indicated that their expectations were met, and that the content covered in the training was helpful. They were primarily expecting to gain information on what to do in case of chemical accidents, as well as expecting to network with the community.

Toxics users desire more specificity. Of the 7 toxics users, 3 responded that their expectations were not fully met, indicating that the training was lacking in specificity. This indicates a gap between what the training attendees felt they needed to know and what information the OTA presented. Respondents felt the training could be more specific to individual workplace and emergency preparedness. This finding through our own outreach is consistent with the findings from all audiences we interviewed.

OTA resources are relevant. Three toxics users stated that the OTA resources shown at the training were useful. Specifically, 2 respondents said the climate and flood maps were most beneficial. This indicates that the OTA should continue presenting these resources in the future. This finding through our own outreach is consistent with the findings from RPA surveyees.

Toxics users desire a greater online presence. Respondents said the OTA's current information on their website was beneficial to them and a great resource to have

when looking for information. Respondents also believed this online presence could be expanded upon.

Trainings act as a valuable networking event. Three of the 6 training attendees mentioned, without being prompted, that they valued the opportunity to establish relationships with local first responders.

Toxics users desire more focus on weather specific to the northeastern region. Two of 3 toxics users who provided feedback desired information more relevant to the northeast, such as winter weather preparedness and hurricanes moving north.

OTA's TUR recommendations can be difficult to implement. Three out of 9 toxics users are in the process of implementing or have already made changes based upon OTA trainings. All 3 of these respondents indicated difficulties in the implementation recommendations from OTA.

Companies are moving towards TUR without OTA assistance. Six out of 9 respondents indicated that they were not taking action based on OTA assistance. Of these 6 companies, 5 indicated they are making TUR changes using resources other than the OTA.

Toxics users are willing to work with OTA in the future. Five out of 5 respondents indicated interest in working with the OTA in the future.

Individuals who have hosted site visits are willing to work with OTA in the future. All 6 of the site visit participants who were asked if they would work with the OTA in the future showed willingness to do so.

Recommendations

Our evaluation process resulted in recommendations for improvements to the OTA's program. These recommendations are aimed at making the OTA's valuable information more accessible to a larger audience while simultaneously addressing the unmet needs of various niche groups.

Recommendations for Trainings

- *OTA should expand their services or work with other state agencies to fulfill the unmet needs of businesses who are not required to report under TURA.*
- *OTA should develop webinar versions of the training, available online through their website.*
- *OTA should develop another supplemental training with a hands-on approach to emergency preparedness.*
- *OTA should provide more focus on severe weather in the northeast region.*

Recommendation for Site Visits

- *OTA should improve the marketing of their services to increase awareness of their services.*

Recommendation for Online Resources

- *OTA should make TUR resources accessible online through their website.*

Recommendation for Data Collection and Organization

- *OTA should utilize centralized online surveying tools to improve data collection, consistency, and organization.*

Conclusion

Our project has demonstrated that while the OTA program meets the needs of many, their services could certainly benefit from improvements that could promote them to a larger audience while simultaneously increasing how effective and impactful they are to their clients. Our findings and recommendations have been presented to the OTA and sparked conversations and ideas to better meet the needs of their program, thereby helping to make Massachusetts a safer place to live and work.

Chemical Safety and Climate Change Resiliency

Chapter 1. Introduction and Background

As the average temperature of the Earth continues to rise, there has been an increase in the frequency and severity of weather patterns (National Climate Assessment, 2014). These severe weather patterns cause flooding and can include spikes in wind gusts, heat, and extreme precipitation, which can pose dangerous risks to facilities which store toxic chemicals. For example, in 2017, massive flooding from Hurricane Harvey caused the refrigeration system at the Arkema plant, one of the largest chemical plant compounds in the nation, to be disabled, leaving large quantities of dangerous substances uncooled (Bratspies, 2018). Lack of emergency planning for power loss left these toxic chemicals in a vulnerable, volatile state, leading to spontaneous combustion. In addition to these devastating blasts at the Arkema plant, Hurricane Harvey's heavy winds, rain, and flooding caused widespread oil spills in the area and lightning strikes caused serious fires to start in crude oil containment structures (Kirby, 2017).

Though much effort has already been dedicated to severe weather preparedness and chemical safety, that does not necessarily mean that the steps taken to be prepared for such an emergency again are sufficient. Just because a facility, such as Arkema, has storage space for chemicals, climate control and refrigeration features, or emergency stop procedures, does not mean that they are invulnerable to the effects of severe weather (Kirby, 2017).

The Office of Technical Assistance and Technology's climate change resiliency and chemical safety program provides technical assistance to Massachusetts toxics users, trains first responders and municipal workers to identify chemical risks in their communities and educates toxics users to identify vulnerabilities to climate change or severe weather. The goal of our project was to assess the effectiveness of their program. In this report we provide background information on the implications of chemical safety and climate change, outline the importance of the OTA's work, describe the methods by which we evaluated their program, our findings, and our recommendations to improve the program.

1.1 Risk Posed by Facilities that Use Toxics

Within the United States, there are over 22,000 facilities which use toxic chemicals, creating nearly 26 billion pounds of chemical waste yearly (Environmental Protection Agency, 2015). Of these facilities, over 2,500 are located in flood-prone areas, which can be seen in Figure 1 (Tabuchi et al., 2018). 1,400 of these facilities are located in areas with the highest risk of flooding (Tabuchi et al., 2018).

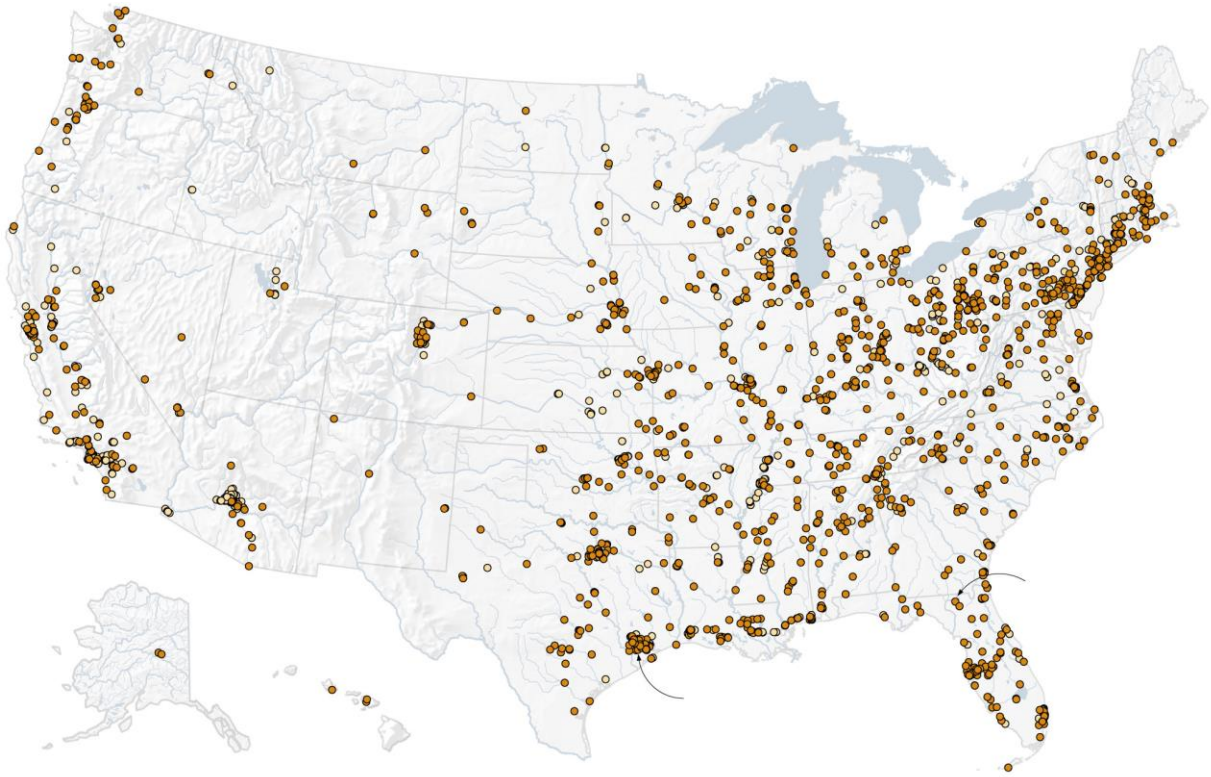

Figure 1. *Toxic facilities that are vulnerable to flooding in the United States. Yellow indicates the facility is at moderate risk of flooding, while orange indicates the facility is at high risk of flooding.*

In Massachusetts alone, there are about 400 toxics using facilities, creating over 55 million pounds of annual chemical waste (Environmental Protection Agency, 2016). A map of these toxics using sites can be seen in Figure 2.

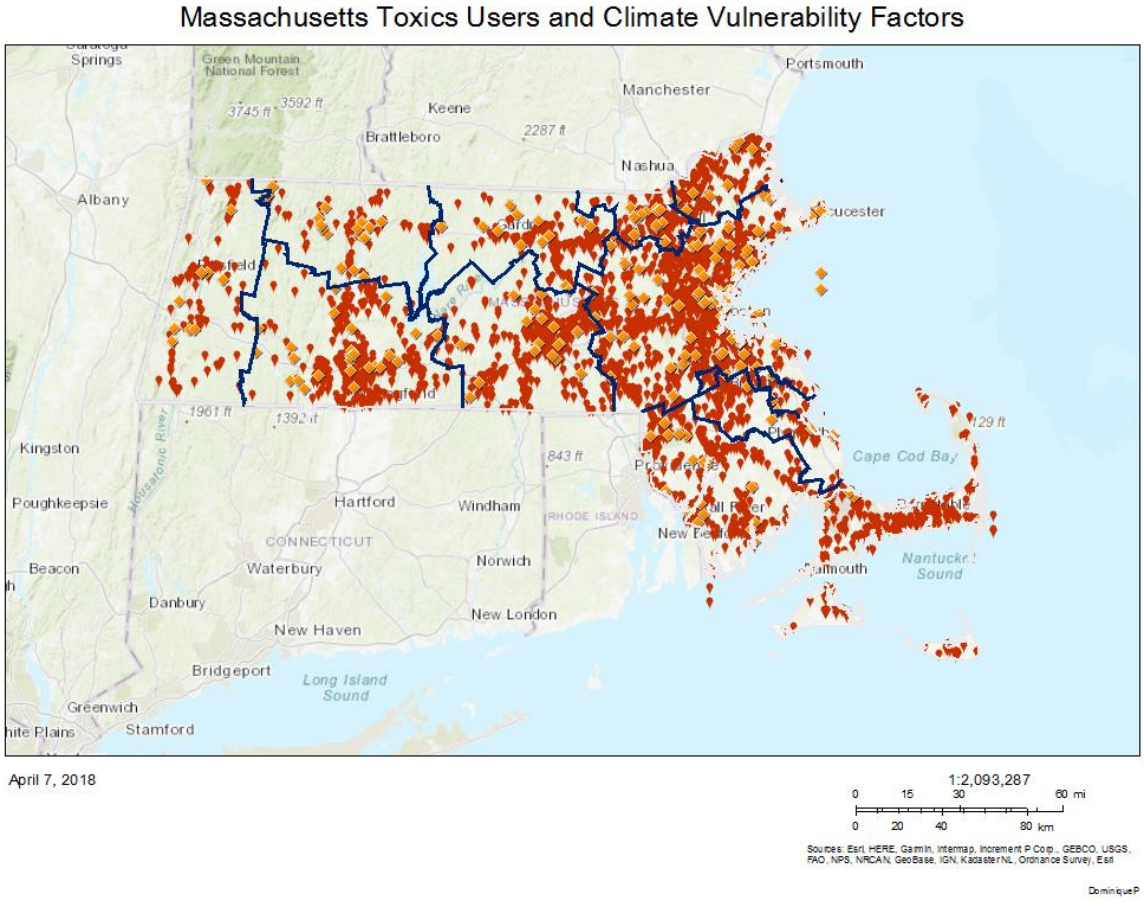

Figure 2. *Toxics use sites in Massachusetts. Orange markers indicate National Pollutant Discharge Elimination (NPDE) discharge sites and red markers indicate EPA-marked Tier 2 sites. Regional Planning Agency boundaries are marked with a dark blue line (Massachusetts Toxics Users and Climate Vulnerability Factors Map).*

Releases from these facilities can endanger the surrounding community and environment with fires, explosions, and exposure to hazardous and dangerous chemicals. Floods, structural damage, and power loss are common causes of chemical release, potentially introducing chemical contaminants to surrounding ecosystems and populations (Missouri Department of Health and Senior Services, n.d.). Examples of events in which weather disasters have caused chemical release are included in Table 1.

Company	Date & Location	Chemical	Weather/ Disaster	Result
Arkema (Platoff, 2018)	August 2017, Crosby, TX	Organic Peroxides	Flooding	Chemical fires, explosions
ExxonMobil (Mufson, 2017)	August 2017, Baytown, TX	Sulfur Dioxide	Heavy rains	Release of sulfur dioxide into air and environment
Chevron Phillips (Atkin, 2017)	August 2017, Sweeny, TX	Carbon Monoxide, Nitrogen Oxide, Ethylene, Propane, 3-Butadiene, Benzene, Butane	Shut down for hurricane	All chemicals listed were released, with potential to harm human respiratory system and inhibit cell function

Table 1. *Examples of chemical disasters caused by severe weather.*

As climate conditions continue to deviate from the norm, toxic chemical users are working to increase facility resilience to unanticipated weather and climate conditions to keep their workers, their community, and their environment safe (Occupational Safety and Health Administration, n.d.).

1.2 Proper Chemical Handling and Storage

Policies and regulations are established to prevent chemical disasters when severe weather conditions cause power outages, structural damage, flooding, or other threats. Specific guidelines are in place that intend to ensure proper usage, storage, handling, and disposal of chemicals which can be dangerous to either their user or to the area around them (International Chemical Safety Cards, n.d.). The lack of proper knowledge of handling chemicals, on any scale, can lead to a potentially dangerous situation (Occupational Safety and Health Administration, n.d.). Every chemical has its own safety data sheet, used to give essential information on safety and health so it may be properly used and disposed of with no harm caused to the handler or the environment around it (Safety Data Sheet, n.d.). If a person responsible for handling chemicals is ill-informed on how to properly handle such chemicals, they increase the risk that some form of accident may occur (KEMI, 2016).

The Centers for Disease Control and Prevention created guidelines that require specific directions to store chemicals to prevent environmental contamination from occurring (Environment Health and Safety Online, 2015). For example, some types of chemicals must be contained in segregated areas, separated from one another

(Environment Health and Safety Online, 2015). This prevents these chemicals from accidently mixing, causing potentially dangerous reactions. It also requires that certain chemicals be stored off the ground, but no higher than eye level, and that the container must be either unbreakable or double contained so that if the initial container breaks, the chemicals will still be secure (Environment Health and Safety Online, 2015).

There are many other factors that have specific requirements for chemical storage, such as temperature, ignition control, and ventilation of the storage room containing the chemicals (Environment Health and Safety Online, 2015). Adequate ventilation prevents buildup of potentially dangerous fumes released by chemicals to prevent accidental reactions or health risks to workers breathing in the vicinity (Environment Health and Safety Online, 2015). It is ideal to have chemicals stored away from heat and direct sunlight, and in an area that is monitored in order to ensure that if an issue is to occur that it can be resolved as soon as possible (Environment Health and Safety Online, 2015).

Additionally, facilities and refineries with high risk substances such as petroleum or oil must be located a “safe” distance from population centers to better ensure public safety (Krausmann, 2008). In the event of an emergency, this reduces risk of harm to major populations.

1.3 Reducing Toxic Chemical Usage

While there are many approaches to reducing the risk of accidents involving toxic chemicals, the safest and most efficient solution is to reduce the amount of chemicals that are stored in a given facility (Office of Technical Assistance and Technology, n.d.b). This approach, called toxics use reduction, minimizes the risk of accidents and possible exposure in the event of an emergency (Office of Technical Assistance and Technology, n.d.b).

The regulations which currently work to ensure a safe environment are enforced by the Environmental Protection Agency (EPA), which focuses on end-of-pipe pollution control methods, and the Occupational Safety and Health Administration (OSHA), which focuses on decreasing exposure of toxic chemicals to plant workers. However, a lack of integration between these approaches often results in conflicting outcomes. The EPA’s efforts have often lead to increased exposure to the workers inside of the facility, while OSHA’s have increased exposure in the environment and the surrounding community (Armenti et al., 2011).

Toxics use reduction practices benefit both worker safety and environmental protection, combining the goals of both the EPA and OSHA. Additionally, toxic use reduction greatly benefits companies who are able to implement recommended changes. These companies save money by spending less on chemicals while also having less risk associated with handling and storage (Massachusetts Government, n.d.).

1.3.1 Massachusetts Toxics Use Reduction Act

In 1989, Massachusetts adopted a law to promote the policies of toxics use reduction, titled the Toxics Use Reduction Act (TURA) (Massachusetts Government, n.d.). The goal of TURA is to reduce waste and toxic substances in businesses and

manufacturing (Massachusetts Government, n.d.). In certain industries, TURA requires that businesses with more than 10 employees which use certain listed chemicals above designated thresholds report to the Massachusetts Department of Environmental Protection (MassDEP), pay a fee, and complete toxics use reduction plans every other year.

TURA obligates roughly 600 companies throughout Massachusetts to follow the Act's regulations (Institute, T.U., 2017). TURA has also influenced the European Union to implement their own toxics use reduction as can be seen through the regulatory framework Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) introduced in 2007 (Understanding REACH - ECHA, n.d.).

In order to prevent industrial accidents and the resulting dangers to the environment and community, Massachusetts has created a system of organizations to assist toxic chemical users in improving the safety of their facilities. There are three established entities in Massachusetts which work synchronously to promote TURA:

1. Toxics Use Reduction Institute (TURI), based in the University of Massachusetts Lowell, is a research facility which assists businesses in finding toxic chemical alternatives
2. MassDEP acts as the enforcement body to the Commonwealth, ensuring that companies under jurisdiction of TURA report chemical usage
3. OTA is the outreach arm, providing businesses with free, confidential assistance to adjust to TURA requirements

1.3.2 Overview of Office of Technical Assistance and Technology Services

The OTA's main goal is "to support the growth of environmentally responsible manufacturing and production in the Commonwealth by encouraging businesses to better comply with environmental regulations, implement cost effective toxics use reduction, energy efficiency, water conservation, and other sustainable practices" (Office of Technical Assistance and Technology, n.d.b). In order to support Massachusetts businesses, the OTA provides free, confidential technical services to assist them in toxics use reduction. An EPA grant allowed the OTA to partner with Regional Planning Agencies to hold free training sessions for first responders, municipal workers, toxics users, and other invested individuals in need of the OTA's services. Details of their services can be seen in Table 2 below.

<table>
<tr><th>Service</th><th>Chemical Safety and Climate Change Resiliency Training 1</th><th>Chemical Safety and Climate Change Resiliency Training 2</th><th>Site Visits</th></tr>
<tr><td>Purpose</td><td>● Training to inform first responders and municipal workers of the importance of chemical safety and climate change resiliency and the chemical safety risks and climate change vulnerabilities in their area</td><td>● Training to inform toxics users of the importance of chemical safety and climate change resiliency</td><td>● Specialized technical assistance provided on site to participants
● Offered at all times at company’s request</td></tr>
<tr><td rowspan="2">Outcomes</td><td>● Attendees may recruit known toxic users to attend Training 2 and refer companies to OTA</td><td>● Companies may opt to receive personal consultation with the OTA</td><td rowspan="2">● Facility evaluated for opportunities to implement TUR practices
● Consultation may result in decreased toxics usage, energy consumption, or waste production, also leading to financial benefits
● OTA may remain in close contact with company and continue to assist in implementing TUR
● OTA compiles case studies of successful outcomes</td></tr>
<tr><td colspan="2">● Pre- and post-training surveys modified and administered by each regional planning agency (RPA)
● Increased understanding of importance of emergency preparedness and TUR
● Increased awareness of OTA services and resources
● Attendees may provide referrals of organizations in need of assistance
● Formation of relationships between first responders and toxic users, creating a more prepared community</td></tr>
</table>

Table 2. *The components of the OTA program, their purposes, and the outcomes of each component.*

1.3.3 Application of Toxics Use Reduction by the OTA

The OTA compiles case studies of successful outcomes of their technical services. The following section summarizes two OTA case studies in which toxics use reduction was employed.

Based upon OTA recommendations, 912 Auto Center switched from solvent-based to water-based tools and materials. This change eliminated the use of two solvent based paint gun washers, Naked Gun Cleaner and a lacquer thinner. Naked Gun Cleaner contains acetone and butyl acetate as the active ingredients, which cause this product to be classified as hazardous by OSHA, risking flammability, neurological toxicity, and eye and skin irritation. The lacquer thinner contains acetone, naphthalene, toluene, and xylene. Use of this product presents hazards such as flammability, carcinogenicity, endocrine disruption, reproductive, developmental, and neurological toxicity, eye and skin irritation, and high aquatic toxicity. Lacquer thinner also had to be disposed of as hazardous waste, which also cost the company hundreds of dollars annually. The shop now uses water-based Acustrip as its paint thinner, which is considerably less toxic. 912 Auto Center also made changes to their paint formula, switching from a solvent-based mix to one which is water-based. Their previous solvent contained the same chemicals and included the same risks as the previously mentioned lacquer thinner. The savings from the eliminated solvent cover the cost of the water soluble pigments. In all, the 912 Auto Center amassed a yearly savings of over $3,300 per year, as well as reducing risk to the workers, the community, and the environment (Office of Technical Assistance and Technology, n.d.a). Table 3 below shows the financial benefits this company received after implementing OTA recommendations.

912 Auto Center

Eliminated Product	**Use**	**Cost**	**Total**
Naked Gun Cleaner	60 gal/year	$120 per 5 gal drum	$1,440/year
Lacquer Thinner	120 gal/year	$52 per 5 gal drum	$1,248/year
Hazardous Waste Disposal	N/A	$350 per 6 mos.	$700/year

Introduced Product	**Use**	**Cost**	**Total**
Acrastrip	5 gal per 6 years	$189 per 5 gal drum	$31.50/year

Total Annual Savings	$3,356.50/year

Table 3. *Results of OTA partnership with 912 Auto Center.*

Stainless Steel Coatings, Inc. followed OTA recommendations to implement input substitutions and a new production schedule to reduce the use of toxic chemicals and costs of hazardous waste disposal. After much trial and error, Stainless Steel Coatings, Inc. removed 57% of original xylene amounts and all hexavalent chromium, both of which are volatile organic compounds (VOCs). These VOCs compound in the system and can have negative effects on health long term. The new formulation also tripled salt spray corrosion test performance of the coating. While both substituted ingredients are more expensive per unit than the previous ingredients, significantly smaller quantities of each are required to produce the same amount of coating product. To reduce hazardous waste disposal costs, the company now makes larger batches of each product before washing the equipment to make the next product. This eliminates the need to use as much of the solvent used to clean the equipment, reducing yearly hazardous waste disposal costs by 52%. Stainless Steel Coatings, Inc. also made many changes to the infrastructure of the factory which reduced energy costs. All indoor lighting was switched to T-8 bulbs and ballasts or compact fluorescent bulbs, sensors were installed in the offices and restrooms, and parking lot lighting was replaced with LEDs. These efficiency advancements will reduce the facility's carbon dioxide emissions by 14,500 pounds per year, with a return on investment period of under two years. The air compressor system was inspected for leaks and was repaired, ensuring that even in the event of malfunction or system failure, the facility will remain in compliance with

OSHA standards. These renovations cost $12,000 and are expected to save the facility $17,000 annually.

Stainless Steel Coatings, Inc.

Area of Improvement	Yearly Savings Amount
Energy	$1,440
Waste Disposal	$15,160
Carbon Dioxide Emissions	14,500 lbs
Other	$300

Total Cost of Implementation	Total Yearly Savings
$12,000	$17,000

Table 4. *Results of OTA partnership with Stainless Steel Coatings, Inc.*

1.3.4 Barriers for Applications of Toxics Use Reduction

There are many different reasons why companies may not be changing their current practices to adapt to toxics use reduction. TURI conducted a study on the barriers of toxics use reduction based on feedback from 30 companies, identifying several barriers that were continuously defined as primary reasons for not converting practices. These reasons were quality of replacement chemicals, capital cost, productivity, customer requirements or perception, operating cost, conforming to a standard (MA Office of Technical Assistance and Technology, 2008).

Some companies do not believe that changing their current process will decrease productivity, especially when it requires trainings and processes for the workers to learn, when they already have a working plan in place (MA Office of Technical Assistance and Technology, 2008). They believe that if they were to apply toxics use reduction, their current process would be slowed, making the change from their current practices detrimental to their business, and therefore not worth the change (MA Office of Technical Assistance and Technology, 2008).

While there are many barriers to applying toxics use reduction methods, the companies mentioned in the TURI report suggested possible actions that could be taken to allow them to overcome these barriers. The most important actions to be taken are better regulatory drivers, stronger incentives, demonstration of available options, cost-benefit information, lab trials of alternatives, product verifications, and tax breaks (MA Office of Technical Assistance and Technology, 2008). Business owners and workers wanted to know whether the new methods that would be implemented truly work as well as, if not better than, their current processes. In addition to improved logistics in their organization, monetary incentive through financial savings and/or increased profitability are essential for influencing change in toxics using companies.

1.4 Assessing the OTA's Toxics Use Reduction Program

The EPA grant allowed the OTA to host a total of 14 toxics use reduction trainings and seminars across the state of Massachusetts in partnership with various Regional Planning Agencies. The OTA plans to continue the program in the future, and hopes to improve it based on the feedback of current participants. The following evaluation of the OTA's program will show how their services can be modified in order to increase effectiveness in spreading knowledge and application of toxics use reduction and assisting businesses who require their services.

Chapter 2. Methods

The goal of our project was to assess the effectiveness of the Office of Technical Assistance and Technology's climate change resiliency and chemical safety program, consisting of trainings and confidential site visits, and develop recommendations for improvements that can be made to the program. The following objectives outline the process that we followed to reach our goal.

1. Objective 1: Developed criteria for determining program effectiveness
2. Objective 2: Evaluated program based on identified criteria
3. Objective 3: Developed and delivered recommendations to the OTA for improving the program

2.1 Objective 1: Develop criteria for determining program effectiveness

Our first objective was to develop criteria by which to evaluate the effectiveness of the program in achieving its goal: increasing awareness of and implementation of chemical safety and climate change resiliency practices. For our purposes, effectiveness referred to the success of the OTA program as defined by the OTA and TURA, program participants, and external organizations with similar programs. To begin identifying possible criteria, we reviewed literature on program evaluation of programs both similar to and different from the OTA's program. We gained an understanding of what types of quantitative data and qualitative information were important to evaluating the OTA through our research of program evaluation, including exploring the effectiveness evaluation process of similar organizations, such as TURI and TNEC. We found two past reports on TURA especially helpful for criteria development; *A Progress Report to the Governor from the Administration Council on Toxics Use Reduction: Toxics Use Reduction in Massachusetts* and *Toxics Use Reduction Act Program Assessment* (Administrative Council on Toxics Use Reduction, 2008; Massey et al., 2006). These resources helped us identify discrepancies and commonalities in practices which we then adapted and refined into the individual final criteria we used in our own evaluation process.

2.2 Objective 2: Evaluate the program based on identified criteria

In order to obtain data to evaluate the program, we first interviewed 9 OTA service participants to receive their feedback. We created three sets of questions for phone interviews to three different audiences: trainings attendees, site visit participants, and RPA surveyees who had opted for more information from the OTA. Seven training attendees were asked their thoughts on the training, if they have made any improvements since training, and were offered a site visit. Two site visit participants were asked what recommendations they received from the OTA, what changes have been implemented, what was useful, and whether there was anything more they had hoped to have been included in the site visit process. RPA surveyees are participants identified by their local regional planning agency as municipal workers, first responders, or potential toxics users. The 189 RPA surveyees who we contacted are those who provided their contact information to their local RPA through a separate initial interest survey, indicating they would like to receive more information from the OTA. Some of these RPA surveyees also filled out an online survey of their experiences with the OTA and indicated whether there was anything more the OTA can offer them. An outline of the questions we planned to ask each audience can be found in Appendix B.

Additionally, we created an online survey which included equivalent questions to our interviews that were applicable to all audiences. This survey allowed us to seek responses from individuals who were not interested in scheduling interviews. Since the online survey contained similar questions to the interview, the results were able to be analyzed in conjunction with the interview responses when compiling the data. This survey was sent to all those who did not participate in an interview.

After completing the interviews with OTA program participants, we were able to use their answers and compare them to our criteria, which are included in Table 6 in section 3.1. Using this table, we were able to compare the survey and interview responses to the criteria in order to make claims of which areas the program is successful in and where it is lacking. This information was used when creating recommendations for improvement and summarizing feedback for the OTA.

2.3 Objective 3: Develop and deliver recommendations to the OTA for improving the program

Our final objective was to develop recommendations to improve the OTA program based on client feedback gathered through our own interviews and surveys, analysis of OTA databases, and comparative analysis of similar programs. Our recommendations are included in this report and were presented to the OTA and representatives from similar organizations in other regions, highlighting successes and different possible approaches to addressing weaknesses in their program.

Chapter 3: Findings

In this chapter we present the results of our analysis. The chapter is divided into two main sections which detail our findings from our first two objectives:

1. Objective 1: Develop criteria for determining program effectiveness
2. Objective 2: Evaluate the program based on identified criteria

Our findings may have some limitations in significance. Our sample size of surveyees and interviewees was quite small. This represents a strong nonresponse bias, as only about 10% of the population of individuals we contacted responded. Our data was also affected by a selection bias. The individuals we contacted had signed up to receive more information about the OTA as part of the training survey that they took. This made them more likely to respond than if they were contacted randomly, and made them more likely to give positive feedback about the training.

Another data discrepancy resulted from the large number of emails which bounced when we conducted outreach requesting that our contacts fill out our survey. This was due to various reasons, such as certain contacts being away from their offices or even certain email addresses no longer being in use. However, that may or may not have happened when we emailed our contacts requesting interviews. When we requested interviews, we had used our OTA issued email addresses, which we soon found did not allow us to receive emails from outside email addresses. Our attempted solution to this issue was to let the recipients know of the problem and ask that they copy our sponsor Tiffany Skogstrom in their response. This meant that the only replies which we received to schedule interviews consisted of the people who were aware of this issue and copied Tiffany in their response. There was no way of knowing how many contacts attempted to reach out to us to schedule an interview because there was no guarantee they copied Tiffany on their response email. We were unable to retrieve any emails which were sent to our OTA email addresses that did not copy Tiffany.

	Interviews	Surveys
Emails Sent	197	
Emails Bounced	Unknown	32
Scheduled Interviews	12	N/A
Completed	9	19
Initial Response Rate	16.3%	N/A
Completion Rate	11.1%	11.5%

Table 5. *Interview and survey outreach and response statistics.*

3.1 Findings from developing criteria for determining program effectiveness

We defined three distinct criteria for our evaluation:

1. Relevance of Services: Relevance of services refers to how well the information given in a particular OTA training pertains to the OTA's audience, or, in this case, our interviewees and surveyees. Relevance of services was determined to be a criteria because we believed it was important that the OTA delivered information that their audience cares about and affects them directly.
2. Relevance of Recommendations: This criterion refers to the ability of an OTA client to implement the changes or teachings given by the OTA through training or technical assistance. It is important that the OTA provides suggestions that are not only sensitive to their clients' needs, but also to their clients' limitations. We learned from TURI documentation that the feasibility of implementing changes (financial, labor-related, etc.) was one of the largest barriers preventing facilities from actively changing (Massey et al., 2006). Factors such as financial burden, labor, and even complacency, among other barriers, may all contribute to the feasibility of accomplishing the OTA's suggestions. See Appendix C for more information from this source regarding benefits from and barriers to implementing TUR-based changes to toxics using facilities.
3. Client Satisfaction: Many of those who responded to our requests for interviews were people who were happy with the OTA services they participated in thus far, and were excited to have a chance to further discuss the services available to them. From this we determined that satisfied clients are more likely to be willing

to continue working with the OTA. We also found that satisfied clients responded with positive phrasing in their answers to our interview questions.

As we maintained open dialogue with Tiffany Skogstrom of the OTA and our project advisor Seth Tuler, our ideas of criteria changed. Their feedback, along with results from some of our initial interviews influenced some refinements in our criteria. For example, during our first three interviews, each subject showed some confusion with our final question, in which we ask the subject to rank their satisfaction with the OTA trainings on a scale of one to seven. It became clear that each interviewee answered the question in the context of how relevant the training was for them. One interviewee shared that the training was nearly useless to him specifically because his company did not operate in the same way that the companies the training was originally designed for do. However, he also stated that he could see how these trainings may greatly benefit other companies. Not only did this participant provide valuable feedback for us to use to create recommendations for the OTA, but the way he answered this question also spurred us to rephrase how some of our questions were presented to specifically address how relevant the trainings are to the individual interviewee. This forced us to reevaluate how we phrased our own criteria and how we evaluated each criterion. These changes were made to clarify exactly what was meant when referring to a “successful program,” without changing the information that we were looking for.

Our criteria are defined in Table 6, which include descriptions of each criterion along with examples of a threshold for success. These criteria served as a consistent and uniform guideline for measuring the effectiveness of the OTA’s services in Objective 2.

Criteria	Description	Example of Success
Relevance of Services	OTA services are relevant to the needs of their clients Information provided directly benefits the organizations seeking help via OTA trainings or other services	5+ rating given Expectations met
Relevance of Recommendations	Clients are able to make changes related to their process, their facility, their trainings, etc. without being completely impeded by barriers (i.e. cost) OTA ability to provide reasonable recommendations, sensitive to the needs of the company with respect to possible barriers	Reduced usage of chemicals and improved chemical storage for severe weather conditions Already implemented or intent to implement changes based on OTA recommendations Revised or intent to revise risk management plan with local first responders
Client Satisfaction	Clients are satisfied with OTA trainings and other services	Inclusion of phrases/words such as “I liked” or “helpful” Willingness to continue to work with the OTA

Table 6. *Criteria for program evaluation with descriptions and examples.*

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3.2 Findings from evaluating the program based on identified criteria

We obtained information from three groups: RPA surveyees, training attendees, and individuals who participated in site visits. RPA surveyees are individuals who completed either the pre- or post-training survey; however, they did not necessarily attend the OTA training, some may have only filled out the pre-training survey. We reference these individuals separately from the other two groups, as they are specifically those individuals who allowed us to interview them or filled out our follow-up survey.

3.2.1 Findings from RPA Survey Responses

Training attendees filled out a pre-training survey, linked on the informational pamphlet that advertised the training locations and dates, and were given a post-training survey by the RPA which hosted the training. The responses to these surveys

were compiled in order to gain insight into the trends in the opinions of the these individuals, which would then be used to identify and support possible recommendations for the OTA trainings. Our findings from this data compilation are as follows:

Surveyees have a need for and interest in OTA trainings. As can be seen in Figure 3 below, 53.7% of surveyees who took the pre-training survey responded that they had conducted a hazard analysis and prepared an emergency response plan within the last two years. This shows that companies have interest in subjects included in the services that the OTA offers and that their services are relevant to the companies' values. The existence of companies who have not recently conducted the hazard analysis and emergency plan proves that the OTA's services are needed.

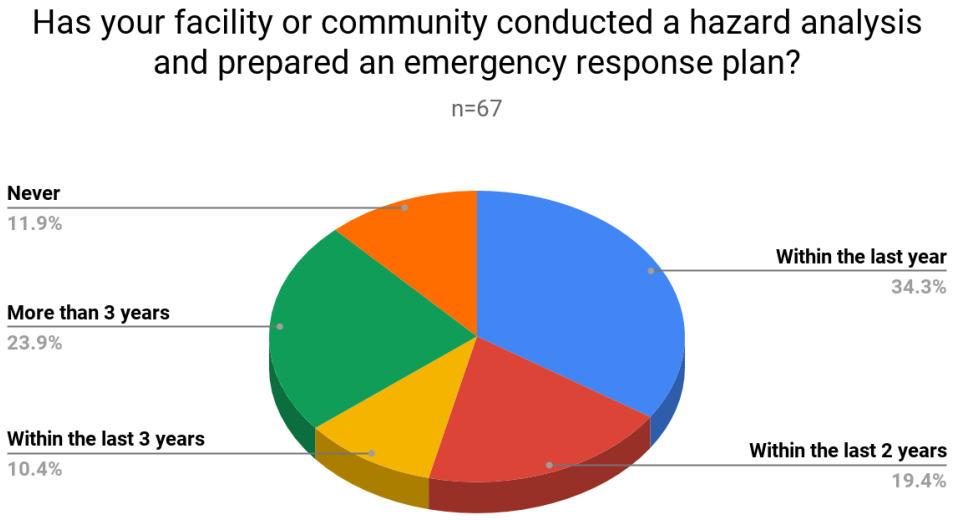

Figure 3. *Distribution of responses to the pre-training survey question "Has your facility or community conducted a hazard analysis and prepared an emergency response plan?"*

Surveyees found the tools and resources presented at trainings inspiring or useful to their situation. Company interest in the trainings is supported by the fact that 77.1% of surveyees responded in the post-training survey that they were beginning to implement changes with the intent of reducing toxic chemical and material usage, as can be seen below in Figure 4.

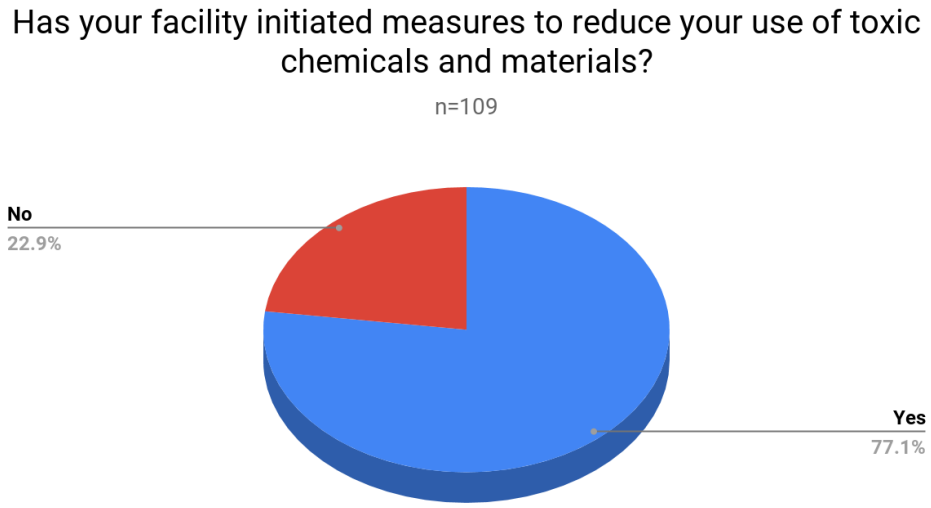

Figure 4. *Distribution of responses to the post-training survey question "Has your facility initiated measures to reduce your use of toxic chemicals and materials?"*

OTA services are insufficiently advertised to the companies who may require assistance. A question on the post-training survey which inquired about the surveyees familiarity about the OTA's confidential technical services received results that indicate just over half of the training attendees were unaware of the OTA's technical services. The disparity between the response rate for the previous question and this one, which can be seen in Figure 5 below, shows that many of the companies who could benefit most from the OTA's technical assistance are unaware of these services. It is important to note that these may be businesses who have just become familiar with the OTA's training through a referral from an RPA or first responder, and therefore may not be familiar with the OTA's technical assistance program at all.

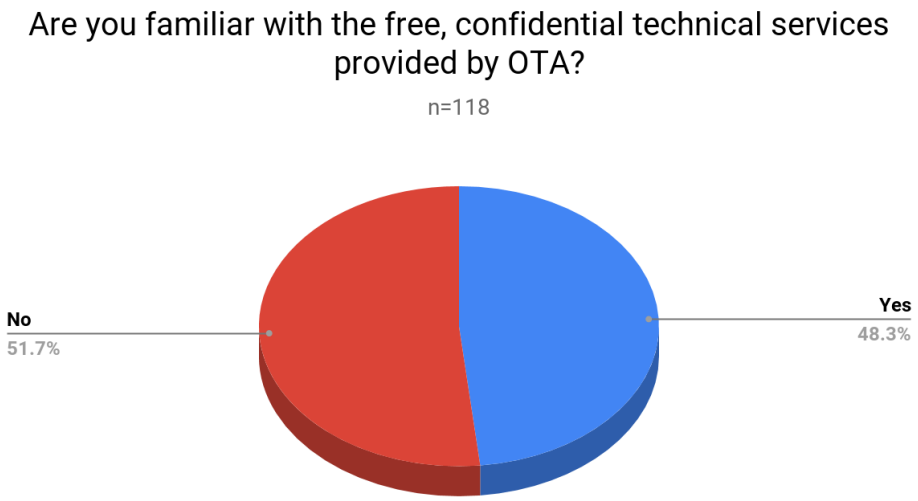

Figure 5. *Distribution of responses to the post-training question "Are you familiar with the free, confidential technical services provided by the OTA?"*

3.2.2 Findings from Our Interviews and Surveys

We scheduled 12 interviews with OTA participants through contact information given to us by the OTA. In total, we interviewed 9 of these people, including 7 toxics users, 1 municipal worker, and 1 first responder. 2 of these interviewees had had site visits in the past.

We received 19 responses to the survey that we had sent out, asking questions that were similar to our interviews so that we might compare the data from both. Providing personal information alongside the survey was optional, and of those who left their information we were able to tell that we received responses from 2 toxics users and 2 municipal workers. We had 7 survey respondents that had had a site visit with the OTA previously.

3.2.2.1 Findings from First Responder Responses

We only received 1 response from a first responder, in the form of an interview, so we do not have much information from which to base our findings on effectiveness of the program for first responders. From their response, we were able to gather:

- *Trainings met this first responder's expectations.* The first responder who we interviewed indicated the content and OTA resources covered in the training met their expectations.
    - Expected overview of climate change and chemical safety
        - Expectations were somewhat met
        - Overview of OTA resources was sufficient
- *Trainings could benefit from an active, hands on, or mock disaster scenario component.* The respondent suggested the addition of hands on activities in order to increase audience engagement.

- Interviewee indicated trainings do not address “a strong need to do… real time training, in other words, doing a mock session”, and that trainings should be held more often

3.2.2.2 Findings from Municipal Worker Responses

We received 3 responses from municipal workers, which had some commonalities in their responses. We learned that:

- *Trainings met municipal worker expectations.* Respondents indicated that their expectations were met, and that the content covered in the training was helpful in their situation.
  - Municipal workers expected to be provided with information on what to do in case of chemical accidents and floods, as well as an opportunity to network with the community
    - One responded that while the training did cover past accidents, they would have preferred greater focus on accident prevention in the future
    - One respondent found the examples of previous accidents beneficial
    - One respondent said the training made them more aware of chemical safety and now puts it into consideration in their work
    - One respondent felt that the training could be improved by focusing more on how to prevent accidents
  - Average training relevance score was 4.3/7, meaning municipal workers found the training more than somewhat relevant

3.2.2.3 Findings from Toxics Users Responses

We received 11 responses from toxics users, 8 of which attended trainings. From this, we were able to gather that:

- *Attendees desire more specificity.* Of the 7 respondents who had expectations, 3 responded that their expectations were not fully met. This indicates a gap between what the training attendees felt they needed to know and what information the OTA presented.
  - Three felt that it was lacking in specificity
    - Missing specificity to individual workplaces, therefore lacking applicability to attendee situations
    - Lacking specificity of emergency preparedness
    - One respondent felt no new information was given
  - Four felt that their expectations were met
  - Three respondents indicated that they expected to learn about safety pertaining to specific chemicals in certain situations, such as in recycling processes, repair shops, or medical waste
- *OTA resources are relevant.* Respondents stated that the OTA resources shown at the training were useful. Specifically, respondents said the climate and flood maps were most beneficial. This indicates that the OTA should continue presenting these resources in the future.
  - Three found the OTA resources beneficial

        - Two specifically mentioned the climate and flood maps
    - Average training relevance score was a 5.1/7, meaning it was relevant.
- *Attendees desire a greater online presence.* Respondents said the OTA's current information on their website was beneficial to them and a great resource to have when looking for information. There were also respondents who believed this online presence could be expanded upon.
    - Two respondents mentioned OTA's online resources
        - One said that "It's very helpful to know where to look for information on various topics"
        - One specifically desired an online database of chemicals
- *Trainings act as a valuable networking event.* Three of the six training attendees mentioned, without being prompted, that they valued the opportunity to establish relationships with local first responders.
    - Three found being able to network with others was beneficial
        - Two specifically mentioned being able to make arrangements with fire departments to be beneficial
- *Attendees desire more focus on weather specific to the northeastern region.* We discovered that attendees desired severe weather information to be more relevant to their area.
    - Three gave feedback on what they felt could have been added to make the training more beneficial to their needs
        - Winter weather preparedness
        - More specific information on emergency preparedness, such as for hurricanes moving north
- *OTA's TUR recommendations are difficult to implement.* Three out of nine respondents are in the process of implementing or have already made changes based upon OTA trainings. All three of these respondents indicated difficulties in the implementation of said changes.
    - Three respondents indicated difficulties with implementing changes
        - One was having difficulty implementing changes because they are unsure what chemicals are should be used
        - One considers the bureaucracy and long procedures challenging, but says "advantages of making the change outweigh the problems"
        - One said their investors want quick payback (2-3 years), and may not consider implementing any changes that take longer
    - One respondent's company halted production of new nanoparticle based on environmental and safety concerns
    - One respondent said they had not begun to implement changes because they believed it was not applicable to their company
- *Companies are moving towards TUR without OTA assistance.* Six out of nine respondents indicated that they were not taking action based on OTA assistance. Of these six companies, five indicated they are making TUR changes using resources other than the OTA.
    - Four provided specific changes they are making towards TUR

        - Changes include using products containing less glycol, updated ventilation systems, and improved chemical storage
        - One respondent said they were working with an OSHA engineer on implementing TUR practices
- *Toxics users are willing to work with OTA in the future.* All five respondents indicated interest in working with the OTA in the future.

3.2.2.4 Findings from Site Visit Participant Responses

Nine respondents had had a site visit with the OTA previously. From them, we learned:

- *Individuals who have hosted site visits are willing to work with OTA in the future.* We discovered that all of the site visit clients who we reached out to were willing to work with or continue working with the OTA in the future.
    - All six respondents who were asked if they would work with the OTA in the future showed willingness to do so
        - When asked about site visits, interviewees responded with comments such as:
            - It is a “no brainer” to use OTA services
            - OTA is “one of the best kept secrets in Massachusetts”
            - “OTA is a great resource to have”
- *Site visit recommendations were relevant to the company’s needs.* We discovered that those who have had site visits in the past held the OTA in high regard and found the recommendations made by the OTA during their site visit to be relevant.
    - Two were asked how they would rate the relevance of the site visits on a scale of 1 to 7 (1 being not relevant, 7 being most relevant)
        - Both gave site visits a 7, showing the site visits to be an extremely relevant and beneficial service

Chapter 4: Recommendations & Conclusion

Our evaluation process provided information to recommend specific improvements and general recommendations for the OTA. These recommendations are aimed at making the OTA’s valuable information more accessible to a larger audience while simultaneously addressing the unmet needs of various niche groups.

4.1 Recommendations for Trainings

Our evaluations, especially our interview process, gave us some useful insight into what clients of the OTA are seeking to learn from the trainings. Recommendations come directly from desires that we found to be common between interviewees.

OTA should expand their services or form partnerships to fulfill the unmet needs of businesses who are not required to report under TURA. These types of businesses are not the ones that the OTA was originally created to work with, since they do not pay TURA fees. However, the OTA may be able to expand the reach and sphere of influence of their services if they are able to provide referrals, direct these companies to helpful resources, or form partnerships with other agencies to meet the need that has

been demonstrated by companies who have attended trainings. Should there be no agencies that would be able to provide business assistance for a new industry sector, the need could be relayed higher up, such as to the Executive Office of Energy and Environmental Affairs (EOEEA), to create resources for these kinds of businesses. This recommendation was based on the responses of three of the toxics users, stating that their expectations of the training were not met because they lacked information that was relevant to them or their company and felt the information could have been much more specific to their fields.

OTA should develop webinar versions of the training, available online through their website. These webinar sessions could supplement the in-person sessions which the OTA conducted in order to reach a larger audience. We were made aware of difficulties regarding travel which resulted in various representatives of participating organizations being unable to attend. This was derived from toxic user interview comments about a desire for more online resources.

OTA should develop another supplemental training with a hands-on approach to emergency preparedness. One suggested idea was the inclusion of a hands-on approach to the training, which would focus on demonstrating proper emergency preparedness techniques, highlighted by mock emergency scenarios and response drills. Services such as these are also provided by TNEC, which the OTA may be able to refer companies with these expectations to. Additionally, in the wake of Hurricane Florence as well as the Arkema plant explosion during Hurricane Harvey, the suggestion of an emergency preparedness training tailored towards hurricane preparedness was also mentioned by multiple people during interviews. This recommendation was supported by our interview with a first responder who believed this would increase engagement and be more effective.

OTA should provide more focus on severe weather in the northeast region. In order to cover the needs of businesses in the northeastern region, the training should provide assistance with emergency preparedness specifically tailored to the region, focusing on severe winter weather and hurricane preparedness. This recommendation was supported by two of our interviews with toxics users, which stated their desire for more information on winter weather and hurricane preparedness specifically based on the northeast region.

4.2 Recommendations for Site Visits

The site visits were regarded highly by those who had participated in them. One of the interviewees referred to the site visits as one of the “best kept secret[s] in the state of Massachusetts”, which is a compliment to the OTA’s services, but also suggests a lack of awareness of the service. While there is a lack of awareness, there also seems to be a lack of understanding of what the service entails. There were several times where interviewees would say that they would not want or think they needed a site visit because they felt their situation would not be covered with the OTA’s help.

OTA should improve the marketing of their services to increase awareness of their services. Since the visits themselves seem to work extremely well, our main recommendation to improve site visits was to improve their marketing. Many people

were unfamiliar with what the site visits did or assumed that they would not be helped by the OTA's assistance, when they possibly could be. It should be stated more clearly that the OTA does more than just general assessments and assist with more specific issues in the workplace. This may be improved through informational videos or webinars on what to expect during a site visit, which would also allow access for more people. Our interviews with toxics users who had not previously had site visits did not believe their company's situation would be covered with the help of the OTA. While in some cases this may be true, there were other cases where respondents said they would not like a site visit, claiming they needed more than a general overview.

4.3 Recommendation for Online Resources

OTA should make TUR resources accessible online through their website. Several interviewees brought up ideas of things they wished to be able to access through the OTA's website. One of the suggestions made was to have an online database of chemicals and information about their usage, which, unbeknownst to the interviewee, was already offered through TURI as part of their online resources. Something like this could possibly be added as a link to the OTA website in a resources tab, or maybe its own dedicated section, as it was something a lot of individuals who access the website seemed to be interested in. An interview with a toxics user revealed that this database of chemicals would be a resource they would often utilize if accessible.

4.4 Recommendation for Data Collection and Organization

Some of the issues which we encountered which made the evaluation process more difficult were related to the data collection and organization methods which the OTA and RPAs used. From the beginning, the baseline questions which the survey consisted of were not clearly defined or presented and instead required responses differed based on each RPA. Data collection was primarily done through online surveys which were then transcribed into a spreadsheet, organizing the response data by RPA. This led to mostly incomparable data sets that had to be manually sorted to extract very few results from.

OTA should utilize centralized online surveying tools to improve data collection, consistency, and organization. As a solution to the data collection and organization issues which we encountered, we recommend the use of an online survey tool such as Google Forms. When these surveys are not conducted through a single source, it allows for the discrepancies in the data, especially if there are different questions on each survey. Although tools may have been used for some of the individual RPA surveys, the surveying process can be improved by centralizing the data in a way which allows the OTA to receive data through one channel rather than compile data from multiple sources. Using this tool will allow the surveys to be easily accessible, and make data collection, organization, and analysis easier. Quantitative response data can be easily visualized in the platform, allowing the OTA to make instant assessments of attendee feedback, and can be easily exported to a spreadsheet format. Another recommendation would be to add the different surveys the OTA offers to the website.

This would allow them to collect more feedback outside of trainings, as more people may be able to access and willing to participate in it.

Additionally, we found that it is difficult for the OTA to get responses from companies when trying to follow up via phone calls. Using the aforementioned online survey tool, would provide a possible fix this issue, as it could be used to attract more people who were not willing to spend more time in a phone call.

4.5 Conclusion

Our research has allowed us to evaluate the OTA's program using feedback gathered from its clientele, giving us the ability to deliver recommendations to the OTA to improve its services. Our recommendations can be used by the OTA to widen the scope of its training while also honing in on individuals who require assistance in niche fields and industries. We have observed that the existing program is useful to those who find the training content relevant to their needs, but the OTA's further services are not properly advertised to the individuals who are in need of it.

The OTA trainings have had mixed success with meeting attendee expectations. The most beneficial element of the trainings are the OTA resources which attendees are introduced to and the networking opportunity provided between companies and first responders for emergency preparedness purposes. Attendees feel the training could be improved by having more specific information and examples, focus on severe weather preparedness in the northeast region, and expansion of the OTA's online resources. OTA site visit participants that we interviewed only had good things to say about their experiences, but other respondents who had not participated in site visits were unsure as to how site visits could benefit them, believing that their situation was too unique. The OTA could use this feedback to determine ways to overcome this misconception, showing that site visits can be more than just a general assessment of the workplace and can be more specific to the needs of the company. Those who have participated in site visits held the service in high regard, and better promotion and advertisement of their services may help the OTA to bridge the gap in order to reach out to and assist more companies.

We have established that the Office of Technical Assistance and Technology has extremely valuable, yet underutilized services. While their program has proven beneficial to many, there is more that can be done to reach a larger audience. The results of our project informed the OTA of successes and shortcomings in their program and has identified potential solutions to these issues. Acknowledgement and implementation of TUR concepts can contribute to safer working environments for toxics users across Massachusetts, even when threatened by severe weather. We hope the information we provide to the OTA will assist them in spreading the importance of Toxics Use Reduction.

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Appendix A: Chemical Safety & Severe Weather Outreach Initiative Survey

The following is an OTA produced survey which is given to attendees of the initial training session in order to gauge the initial conditions of the facility and determine whether the OTA's services are applicable and wanted.

1. Does your facility store and maintain hazardous materials on site? **Yes No**
   (If yes, continue with survey. If no, thank you for your time.)

2. Is your facility in a flood zone? **Yes No Unknown**

3. Has your facility initiated measures to reduce your use of toxic chemicals and materials? **Yes No**

4. Describe actions (optional):

5. Has your facility conducted a hazard analysis and prepared an emergency response plan:

Answer	Check one
Within the last year	
Within the last 2 years	
Within the last 3 years	
More than 3 years ago	
Never	

6. Have you reviewed or updated your emergency response plan:

Answer	Check one

Within the last year	
Within the last 2 years	
Within the last 3 years	
More than 3 years ago	

7. Have your employees been trained in spill response and the implementation of your emergency plan:

Answer	Check one
Within the last year	
Within the last 2 years	
Within the last 3 years	
More than 3 years ago	

8. Have you shared and reviewed your emergency procedures with your local fire department:

Answer	Check one
Within the last year	
Within the last 2 years	

Within the last 3 years	
More than 3 years ago	
Never	

9. Has your facility taken actions to reduce its energy consumption:

Answer	Check one
Within the last year	
Within the last 2 years	
Within the last 3 years	
More than 3 years ago	
Never	

Describe actions (optional):

10. Has your facility taken action to reduce its water consumption:

Answer	Check one
Within the last year	
Within the last 2 years	

Within the last 3 years	
More than 3 years ago	
Never	

Describe actions (optional):

11. Are you familiar with the free, confidential technical services provided by OTA? **Yes No**

12. Would you be interested in learning more about how OTA offers free and confidential services to help businesses reduce their use of toxic materials, decrease energy and water consumption, and secures resources such as grants? **Yes No**

13. RPA and OTA will be sponsoring free training sessions geared to communities and businesses with practical tips and suggestions for evaluating and managing chemical safety. Would you like to be included on the invitation list for the trainings planned as part of this initiative? **Yes No**

Appendix B: OTA Participant Interview Questions

Preamble

We are a group of students from Worcester Polytechnic Institute in Massachusetts and we are working with the Massachusetts Office of Technical Assistance and Technology to assist in assessing their chemical safety and climate change resiliency program through participant feedback and data analysis to ensure that the training protocol in place yields successful results and is a functional model going forward.
Your participation in this interview is completely voluntary and you may withdraw at any time. Please remember that your answers will remain anonymous. No names or identifying information will appear on the questionnaires or in any of the project reports or publications. If interested, a copy of our results can be provided through an internet link at the conclusion of the study.

Training Attendee Questions (Municipal Workers/First Responders)

1. Hello, I am a student from Worcester Polytechnic Institute working with the Massachusetts Office of Technical Assistance, or OTA. You attended a Chemical Safety and Climate Change Resiliency training at **[LOCATION]** on **[DATE]**, and signed up to receive more information from OTA. Can I ask you some questions about what you got out of the training? All information that you provide is strictly voluntary and confidential under the Toxics Use Reduction Act.
    - **a. IF YES**
        - i. Can I record this interview?
            1. **IF NO**
                a. We would like to remind you that this is fully confidential, we only record the phone call to ensure consistency between what you said and our notes. The recording will not be used for any other purposes. Do you mind reconsidering?
2. What skills or information were you hoping to receive from this training?
    - a. Were your expectations for the training met?
    - **b. IF YES**
        - i. What was most beneficial about this training, and why?
        - ii. What do you wish the training had addressed, and why?
    - **c. IF NO**
        - i. How did the training not meet your expectations?
        - ii. Which of your expectations about the training were met?
3. Have you implemented any changes or practice based upon what you learned at the OTA training?
    - **a. IF YES**
        - i. What changes did you make? Why did you make any changes?
            1. What was most difficult about making changes, and why?
            2. What was easiest to change, and why?
    - **b. IF NO**
        - i. Why did you not make any changes?

4. As you may remember from the training, OTA accepts company referrals from fire departments, police, boards of health and other municipal offices. Did you refer any companies to the OTA?
    - **a. IF YES**
        - i. Why?
        - ii. Have you seen changes in that company since referral?
    - **b. IF NO**
        - i. Why not?
5. Are there any other services the OTA can offer you at this time?
6. On a scale of 1 to 7, how relevant did you find the training, 1 being the least helpful and 7 being the most helpful? Please take a moment to consider your answer.
7. Thank you for your participation! Your input is extremely valuable to us and it is much appreciated.

Training Attendee Questions (Toxics Users - Facility managers/directors of operation/business owners - Training 2)

1. Hello, I am a student from Worcester Polytechnic Institute working with the Massachusetts Office of Technical Assistance, or OTA. You attended a Chemical Safety and Climate Change Resiliency training at **[LOCATION]** on **[DATE]**, and signed up to receive more information from OTA. Can I ask you some questions about what you got out of the training? All information that you provide is strictly voluntary and confidential under the Toxics Use Reduction Act.
    - **a. IF YES**
        - i. Can I record this interview?
            - **1. IF NO**
                - a. We would like to remind you that this is fully confidential, we only record the phone call to ensure consistency between what you said and our notes. The recording will not be used for any other purposes. Do you mind reconsidering?
2. What skills or information were you hoping to receive from this training?
    - a. Were your expectations for the training met?
        - **i. IF YES**
            1. What was most beneficial about this training, and why?
            2. Were your expectations for the training met?
        - **ii. IF NO**
            1. How did the training not meet your expectations?
            2. Which of your expectations about the training were met?
3. Have you implemented any changes or practice based upon what you learned at the OTA training?
    - **a. IF YES**
        - i. What changes did you make? Why did you make any changes?
            1. What was most difficult about making changes, and why?
            2. What was easiest to change, and why?
    - **b. IF NO**
        - i. Why did you not make any changes?
4. Have you had a site visit with the OTA?
    - **a. IF YES**
        - i. Why?

ii. What changes have been implemented based on OTA recommendations?
iii. Was there anything that was difficult about making changes?

b. IF NO

i. Why not?
ii. Would you like to have a free & confidential site visit?
iii. Be prepared to give more information on site visits

5. Are there any other services the OTA can offer you at this time?
6. On a scale of 1 to 7, how useful/helpful/beneficial did you find the training? 1 being the least helpful and 7 being the most helpful. Please take a moment to consider your answer.
7. Thank you for your participation! Your input is extremely valuable to us and it is much appreciated.

Individuals who have hosted Site Visits at their facility

1. Hello, I am a student from Worcester Polytechnic Institute working with the Massachusetts Office of Technical Assistance, or OTA, to assess their services by obtaining feedback from those who have participated. Your company, **[COMPANY NAME]**, previously hosted a site visit with a field service technician from the OTA on **[DATE]**. Under the Toxics Use Reduction Act, all information that you provide is strictly voluntary and confidential. Can I ask you some questions?
    a. IF YES
        i. Can I record this interview?
            1. IF NO
                a. We would like to remind you that this is fully confidential, we only record the phone call to ensure consistency between what you said and our notes. The recording will not be used for any other purposes. Do you mind reconsidering?
2. Did you attend a training?
    a. **IF YES**
        i. What skills or information were you hoping to receive from this training?
        ii. Were your expectations for the training met?
            1. IF YES
                a. What was most beneficial about this training, and why?
                b. What do you wish the training had addressed, and why?
            2. IF NO
                a. How did the training not meet your expectations?
                b. Which of your expectations about the training were met?
        iii. Did you get a site visit through a training?
        iv. Was the training useful?
            1. Why/why not?
    b. IF NO
        i. How did you first hear about the OTA's services?
3. What did you find most useful about the site visit? Why?
4. Was there anything you did not like? Why?
5. Was there anything you found not to be useful? Why?
6. Have you implemented or are you planning to implement any changes based on recommendations from the site visit?

a. IF YES

i. What changes did you make? Why did you make any changes?

1. What was most difficult about making changes, and why?
2. What was easiest to change, and why?

b. IF NO

i. Why not?

7. Are there any other services the OTA can offer you at this time?
8. Would you welcome OTA back in the future? Why?
9. Is there anything else you would like to say about the OTA?
10. On a scale of 1 to 7, how useful/helpful/beneficial did you find the training? 1 being the least helpful and 7 being the most helpful. Please take a moment to consider your answer.
11. Thank you for your participation! Your input is extremely valuable to us and it is much appreciated.

RPA Surveyees

1. Hello, I am a student from Worcester Polytechnic Institute working with the Massachusetts Office of Technical Assistance, or OTA, to assess their services by obtaining feedback from those who have participated. You provided your contact information in a survey that the OTA had sent to you. Under the Toxics Use Reduction Act, all information that you provide is strictly voluntary and confidential. Can I ask you some questions?

a. IF YES

i. Can I record this interview?

1. IF NO

a. We would like to remind you that this is fully confidential, we only record the phone call to ensure consistency between what you said and our notes. The recording will not be used for any other purposes. Do you mind reconsidering?

2. Did you attend a training?

a. **IF YES**

i. What skills or information were you hoping to receive from this training?

ii. Were your expectations for the training met?

1. IF YES

a. What was most beneficial about this training, and why?
b. What do you wish the training had addressed, and why?

2. IF NO

a. How did the training not meet your expectations?
b. Which of your expectations about the training were met?

iii. Was the training useful?

1. Why/why not?

b. IF NO

i. How did you first hear about the OTA's services?

ii. Why didn't you attend a training?

iii. Are you still interested in a site visit from OTA?

iv. Thank you for your participation! Your input is extremely valuable to us and it is much appreciated.

v. END OF INTERVIEW

3. Have you implemented any changes or practice based upon what you learned at the OTA training?
    - **a. IF YES**
        - i. What changes did you make? Why did you make any changes?
            1. What was most difficult about making changes, and why?
            2. What was easiest to change, and why?
    - **b. IF NO**
        - i. Why did you not make any changes?
4. Have you had a site visit with the OTA?
    - **a. IF YES**
        - i. Why?
        - ii. What changes have been implemented based on OTA recommendations?
        - iii. Was there anything that was difficult about making changes?
    - **b. IF NO**
        - i. Why not?
        - ii. Would you like to have a free & confidential site visit?
        - iii. Be prepared to give more information on site visits
5. Are there any other services the OTA can offer you at this time?
6. On a scale of 1 to 7, how useful/helpful/beneficial did you find the training? 1 being the least helpful and 7 being the most helpful. Please take a moment to consider your answer.
7. Thank you for your participation! Your input is extremely valuable to us and it is much appreciated.

Appendix C: Benefits Vs. Barriers Table of OTA Services

Benefits	**Barriers**
Long term financial savings	High costs of implementing changes
Improved workplace safety	Time consuming to implement
Improved worker health and safety	Low priority to management
Production efficiency improvements	Lack of support from supply chain partners
Improvements to product quality	Technical feasibility issues
Compliance with State and federal regulations	Unawareness of benefits
Physical infrastructure improvements	Lack of sufficient staff to work on the implementation
Product marketing opportunities	Hesitation to change product formulation
Management involvement in environmental practices	

The OTA's services are applicable to many different types of companies and organizations. Each one faces a set of possible benefits that may come from working with the OTA, along with a set of barriers that may prohibit them from taking advantage of OTA services. This chart attempts to illustrate some of the major factors that these companies consider before working with the OTA. This information has been compiled through both official TURI documents and the input of OTA officials (Massey et al., 2006).

Appendix D: Table of Criteria

Criteria	**Description**	**Example of Success**
Relevance of Services	OTA services are relevant to the needs of their clients Information provided directly benefits the organizations seeking help via OTA trainings or other services	5+ rating given Expectations met
Relevance of	Clients are able to make changes	Reduced usage of chemicals

Recommendations	related to their process, their facility, their trainings, etc. without being completely impeded by barriers (i.e. cost) OTA ability to provide reasonable recommendations, sensitive to the needs of the company with respect to possible barriers	and improved chemical storage for severe weather conditions Already implemented or intent to implement changes based on OTA recommendations Revised or intent to revise risk management plan with local first responders
Client Satisfaction	Clients are satisfied with OTA trainings and other services	Inclusion of phrases/words such as “I liked” or “helpful” Willingness to continue to work with the OTA

Outline of criteria for program evaluation as well as an applicable description and an example of a successful response for the given criteria.

Appendix E: Authorship Table

No.	Section Name	Writer	Editor
	Abstract	Shaye Johnstone Danny Sullivan	Matt Cannata
1	Introduction and Background	Matt Cannata	Shaye Johnstone
1.1	Risks Posed by Facilities that Use Toxics	Shaye Johnstone Danny Sullivan	Przemek Gardias
1.2	Proper Chemical Handling and Storage	Przemek Gardias	Shaye Johnstone
1.3	Reducing Toxic Chemical Usage	Shaye Johnstone	Przemek Gardias
1.3.1	Massachusetts Toxics Use Reduction Act	Danny Sullivan	Shaye Johnstone
1.3.2	Overview of Office of Technical Assistance and Technology Services	Shaye Johnstone	Danny Sullivan
1.3.3	Application of Toxics Use Reduction by the OTA	Shaye Johnstone	Danny Sullivan
1.3.4	Barriers for Applications of Toxics Use Reduction	Danny Sullivan	Matt Cannata
1.4	Assessing the OTA's Toxics Use Reduction Program	Shaye Johnstone	Przemek Gardias
2	Methods	Danny Sullivan	Shaye Johnstone
2.1	Objective 1	Matt Cannata	Danny Sullivan
2.2	Objective 2	Przemek Gardias	Matt Cannata
2.3	Objective 3	Danny Sullivan	Przemek Gardias
3	Findings	Przemek Gardias	Matt Cannata
3.1	Findings from developing criteria for determining program effectiveness	Matt Cannata Shaye Johnstone	Danny Sullivan
3.2	Findings from evaluating the program based on identified criteria	Przemek Gardias	Matt Cannata
3.2.1	Findings from RPA Survey Responses	Przemek Gardias	Danny Sullivan
3.2.2	Findings from Our Interviews and Surveys	Danny Sullivan	Przemek Gardias
3.2.2.1	First Responder Responses	Matt Cannata	Przemek Gardias

3.2.2.2	Municipal Worker Responses	Matt Cannata Przemek Gardias Shaye Johnstone Danny Sullivan	Danny Sullivan
3.2.2.3	Toxics Users Responses	Matt Cannata Przemek Gardias Shaye Johnstone Danny Sullivan	Matt Cannata
3.2.2.4	Site Visit Responses	Matt Cannata Przemek Gardias Shaye Johnstone Danny Sullivan	Danny Sullivan
4	Recommendations & Conclusions	Matt Cannata	Przemek Gardias
4.1	Recommendations for Trainings	Matt Cannata	Danny Sullivan
4.2	Recommendations for Site Visits	Shaye Johnstone	Shaye Johnstone
4.3	Recommendations for Online Resources	Przemek Gardias	Danny Sullivan
4.4	Recommendations for Data Collection	Danny Sullivan	Shaye Johnstone
4.5	Conclusion	Danny Sullivan	Przemek Gardias

Glossary of Acronyms

DEP	Department of Environmental Protection
EOEEA	Executive Office of Energy and Environmental Agency
EPA	Environmental Protection Agency
IRB	Institutional Review Board
MassDEP	Massachusetts Department of Environmental Protection
NPDE	National Pollutant Discharge Elimination
OSHA	Occupational Safety and Health Administration
OTA	Office of Technical Assistance and Technology
REACH	Registration, Evaluation, Authorization, and Restriction of Chemicals
RPA	Regional Planning Agency
TNEC	The New England Consortium
TUR	Toxics Use Reduction
TURA	Toxics Use Reduction Act
TURI	To Reduction Institute
QAPP	Quality Assurance Project Plan
VOC	Volatile Organic Compound